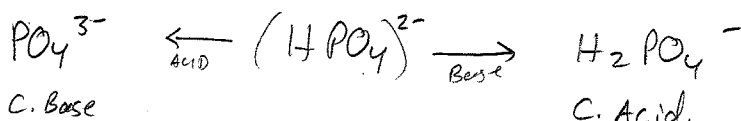


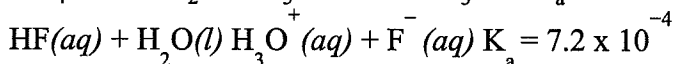
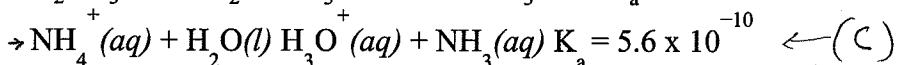
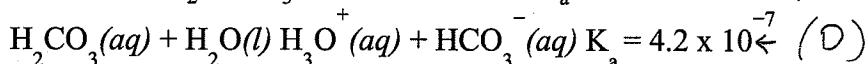
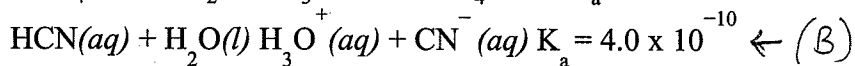
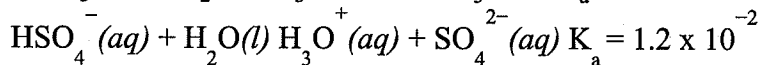
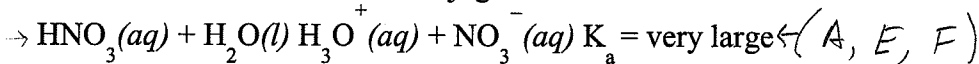
4. Is the monohydrogenphosphate ion HPO_4^{2-} amphiprotic?

If so, write the formulas of its conjugate acid and its conjugate base.



5. Of the following acids, determine

- The strongest acid
- The acid that produces the lowest concentration of hydronium ions per mole of acid
- The acid with the strongest conjugate base
- The diprotic acid
- The strong acid
- The acid with the weakest conjugate base

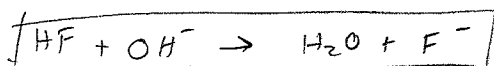
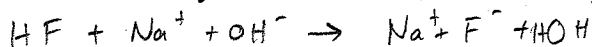


6. Write net ionic acid-base reactions for:

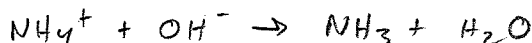
- a. The reaction of acetic acid with aqueous ammonia solution



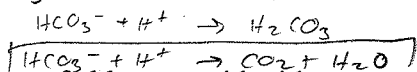
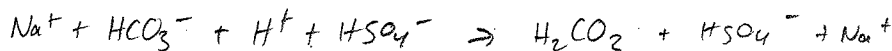
- b. The reaction of hydrofluoric acid with sodium hydroxide



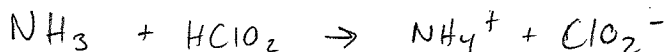
- c. The reaction of ammonium chloride with potassium hydroxide



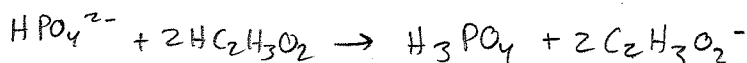
- d. The reaction of sodium bicarbonate with sulfuric acid



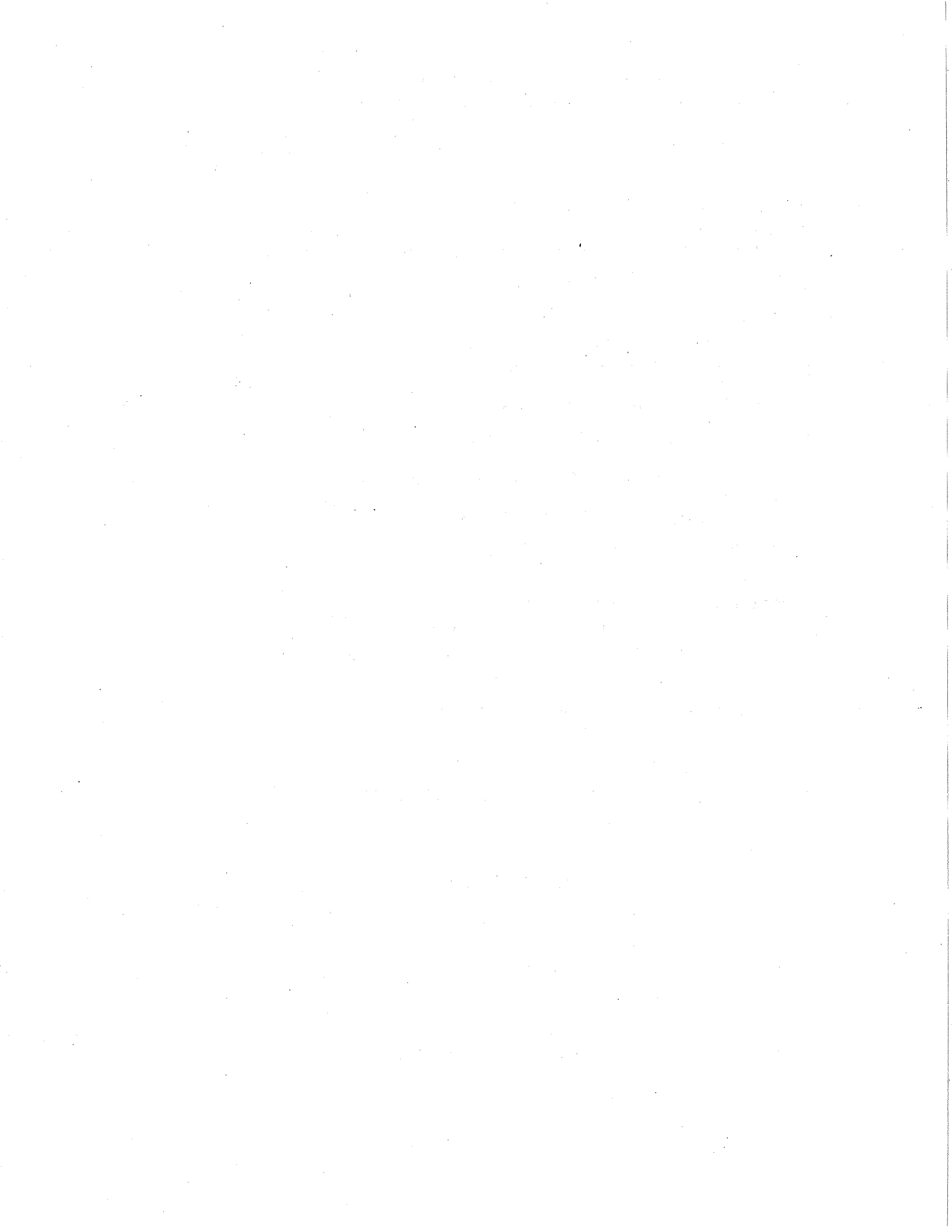
- e. The reaction of chlorous acid with aqueous ammonia solution



- f. The reaction of disodium hydrogen phosphate with acetic acid



or



7. What is the pH of

a. 0.0010 M HCl solution?

HCl ionizes 100% $\Rightarrow [H^+] = 0.0010 M$

$pH = -\log [H^+] = -\log 0.0010 = \boxed{3}$

b. 0.15 M KOH solution?

KOH ionizes 100%

$pOH = -\log [OH^-]$

$pH + pOH = 14$

$= -\log [0.15]$

$pH = 14 - pOH$

$pOH = 0.824$

$= 14 - 0.824$

$= \boxed{13.17}$

c. 10^{-8} M HNO₃ solution?

HNO₃ ionizes 100%

$\therefore [H^+] = 1 \times 10^{-8}$

$pH = -\log [H^+]$

$= -\log [1 \times 10^{-8}] = \boxed{8}$

8. List the following substances in order of increasing acid strength:

H₂O, H₂SO₃, HCN, H₂PO₄⁻, NH₄⁺, [Cu(H₂O)₆]²⁺, NH₃, H₃O⁺, HCO₂H, HCl.

10^{-14} , 1.7×10^{-2} , 4.9×10^{-10} , 6.2×10^{-8} , 1×10^{-8} , 1×10^{-14} , -1.7 , 1.8×10^{-4} , 1×10^{-7}

H₂O, NH₃, HCN, [Cu(H₂O)₆]²⁺, H₂PO₄⁻, NH₄⁺, HCO₂H, H₂SO₃, H₃O⁺, HCl

9. Complete the table for each aqueous solution at 25°C.

State whether the solutions are acidic or basic.

[H ₃ O] ⁺	[OH] ⁻	pH	pOH	acidic or basic
2.0×10^{-5}	5×10^{-10}	4.70	9.3	Acidic
5.62×10^{-7}	1.78×10^{-8}	6.25	7.75	Acidic
1.76×10^{-13}	5.6×10^{-2}	12.75	1.25	Basic
1.58×10^{-5}	6.31×10^{-10}	4.8	9.20	Acidic
8.7×10^{-10}	1.15×10^{-5}	9.06	4.94	Basic

$[H^+][OH^-] = 1 \times 10^{-14}$

10. What is the pH of a solution that contains 2.60 grams of NaOH in 250 mL of aqueous solution?

$\frac{2.60 \text{ g NaOH}}{0.250 \text{ L}} \left| \frac{1 \text{ mol NaOH}}{39.997 \text{ g NaOH}} \right| = 0.260 \text{ M NaOH} = 0.260 \text{ M OH}^-$

$pOH = -\log [OH^-]$

$= -\log [0.260]$

$pH + pOH = 14$

$pH = 14 - pOH$

$pH = 14 - 0.585$

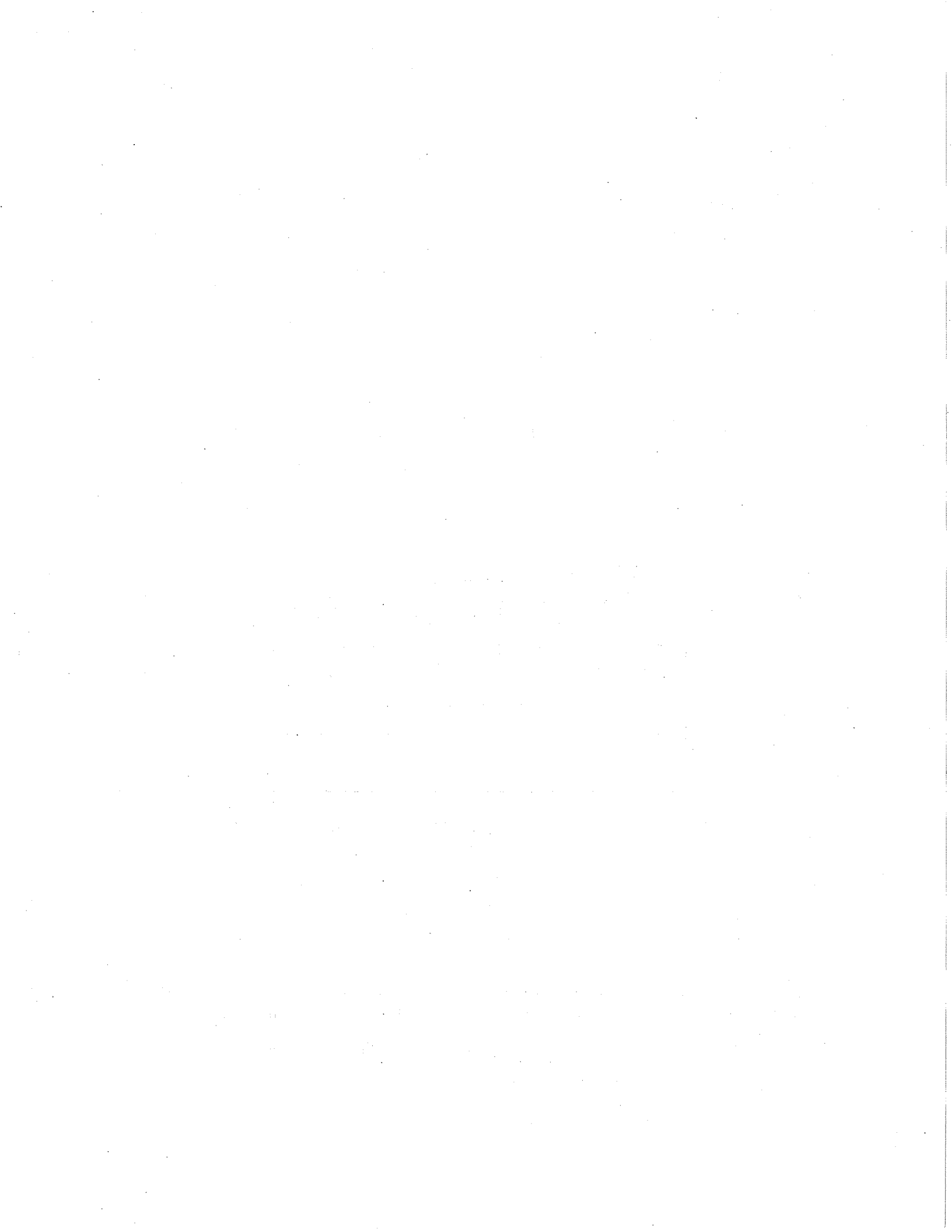
11. If the pH of a sample of rainwater is 4.62, what is the hydronium ion concentration

[H₃O]⁺ and the hydroxide ion concentration [OH]⁻ in the rainwater?

$pH = 13.41$

12. A 0.12 M solution of an unknown weak acid has a pH of 4.26 at 25°C. What is the hydronium ion concentration in the solution and what is the value of its K_a?

13. Hydroxylamine is a weak base with a K_b = 6.6 x 10⁻⁹. What is the pH of a 0.36 M solution of hydroxylamine in water at 25°C?



$$\# 11) \quad \text{pH} = 4.62$$

$$\text{pH} = -\log [\text{H}^+]$$

$$10^{-\text{pH}} = [\text{H}^+]$$

$$10^{-4.62} = [\text{H}^+]$$

$$\boxed{2.399 \times 10^{-5} = [\text{H}^+]}$$

$$\text{pOH} = 14 - \text{pH}$$

$$\text{pOH} = 14 - 4.62$$

$$\text{pOH} = 9.38$$

$$\text{pOH} = -\log [\text{OH}^-]$$

$$10^{-\text{pOH}} = [\text{OH}^-]$$

$$10^{-9.38} = [\text{OH}^-]$$

$$\boxed{4.167 \times 10^{-10} = [\text{OH}^-]}$$

check!

$$[\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14}$$

$$(2.399 \times 10^{-5})(4.167 \times 10^{-10}) = 9.9999 \times 10^{-15} \quad \text{yes that is close}$$



$$\text{I} \quad 0.12 \quad 0 \quad 0$$

$$\text{C} \quad -5.495 \times 10^{-5} \quad +5.495 \times 10^{-5} \quad 5.495 \times 10^{-5}$$

$$\text{E} \quad (0.12 - 5.495 \times 10^{-5}) \quad (5.495 \times 10^{-5}) \quad (5.495 \times 10^{-5})$$

$$\text{pH} = 4.26$$

$$\text{pH} = -\log [\text{H}^+]$$

$$10^{-\text{pH}} = [\text{H}^+]$$

$$10^{-4.26} = [\text{H}^+]$$

$$5.495 \times 10^{-5} = [\text{H}^+]$$

$$K_a = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]} = \frac{(5.495 \times 10^{-5})(5.495 \times 10^{-5})}{(0.12)} = \boxed{2.51 \times 10^{-8} = K_a}$$

13)

$$K_b = 6.6 \times 10^{-9}$$

$$K_b = \frac{[HB^+][OH^-]}{[B]} = 6.6 \times 10^{-9} = \frac{[x][x]}{(0.36)}$$

$$6.6 \times 10^{-9} = \frac{x^2}{0.36}$$

$$2.376 \times 10^{-9} = x^2$$

$$4.874 \times 10^{-5} = x = [OH^-]$$

$$pOH = -\log [OH^-]$$

$$= -\log 4.874 \times 10^{-5}$$

$$pOH = 4.31$$

$$pH = 14 - pOH$$

$$= 14 - 4.31$$

$$pH = 9.69$$